

IEM's AI Modeling: Short-term COVID-19 Projections

Date: 4/8/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 4/8/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

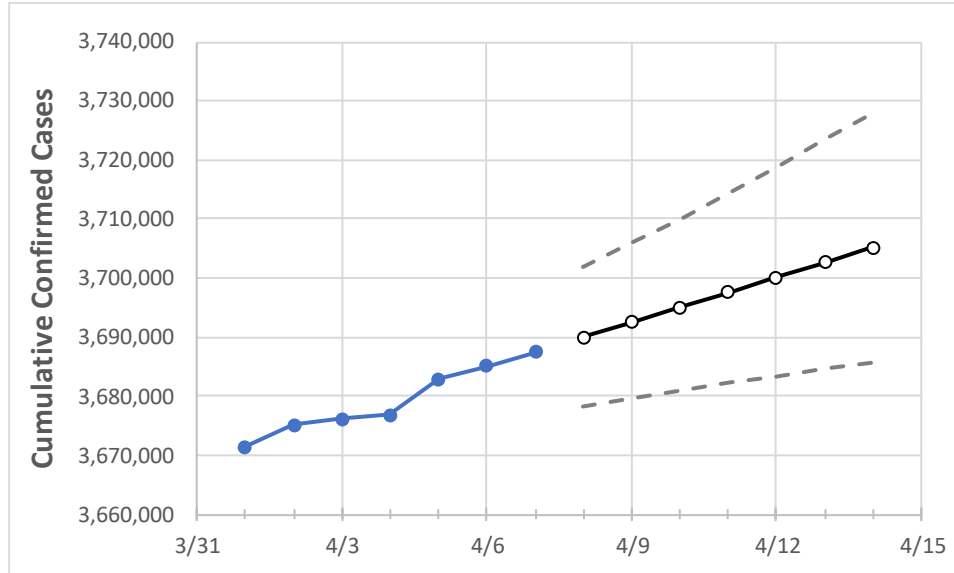
IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

California State Projections



	Actual Confirmed Cases On:				Projected Cases For:							
	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	

California 3,676,742 3,682,861 3,685,045 3,687,493 3,690,039 3,692,534 3,695,064 3,697,630 3,700,151 3,702,706 3,705,223

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

California Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	
Alameda	83,861	83,951	84,007	84,091	84,194	84,298	84,402	84,510	84,619	84,728	84,838	
Contra Costa	65,665	65,718	65,835	65,882	65,955	66,026	66,098	66,170	66,241	66,310	66,380	
Fresno	99,602	99,702	99,755	99,814	99,906	99,996	100,089	100,181	100,267	100,350	100,435	
Kern	106,430	106,480	106,543	106,628	106,663	106,698	106,731	106,764	106,794	106,820	106,846	
Lake	3,350	3,355	3,359	3,358	3,361	3,365	3,368	3,371	3,375	3,378	3,381	
Los Angeles	1,221,950	1,222,479	1,222,802	1,223,205	1,223,663	1,224,106	1,224,540	1,224,996	1,225,431	1,225,859	1,226,280	
Marin	13,724	13,730	13,743	13,760	13,769	13,778	13,787	13,795	13,802	13,810	13,816	
Monterey	42,994	43,002	43,038	43,057	43,069	43,082	43,093	43,104	43,115	43,126	43,137	
Orange	266,822	267,001	267,143	267,253	267,397	267,540	267,684	267,827	267,969	268,114	268,259	
Placer	21,157	21,188	21,239	21,287	21,336	21,387	21,439	21,492	21,546	21,601	21,658	
Riverside	295,196	295,426	295,631	295,770	295,980	296,195	296,416	296,644	296,881	297,130	297,389	
Sacramento	98,660	98,848	99,042	99,157	99,370	99,582	99,798	100,018	100,241	100,474	100,705	
San Bernardino	291,551	291,727	291,728	291,989	292,144	292,299	292,455	292,614	292,771	292,933	293,092	
San Diego	271,335	271,654	271,866	272,194	272,435	272,675	272,909	273,139	273,358	273,581	273,821	
San Francisco	35,488	35,525	35,538	35,572	35,603	35,634	35,665	35,697	35,729	35,762	35,792	
San Joaquin	70,202	70,245	70,465	70,511	70,599	70,686	70,780	70,876	70,968	71,065	71,156	
San Luis Obispo	20,586	20,606	20,649	20,671	20,694	20,716	20,738	20,760	20,783	20,805	20,828	
San Mateo	40,560	40,595	40,618	40,649	40,687	40,725	40,761	40,799	40,836	40,872	40,909	
Santa Barbara	33,329	33,358	33,381	33,408	33,440	33,472	33,504	33,535	33,566	33,598	33,629	
Santa Clara	114,865	115,171	115,266	115,396	115,500	115,601	115,705	115,807	115,908	116,007	116,111	
Santa Cruz	15,292	15,278	15,264	15,283	15,298	15,312	15,327	15,342	15,356	15,369	15,383	
Solano	31,368	31,401	31,432	31,462	31,501	31,538	31,577	31,614	31,652	31,691	31,729	
Sonoma	29,315	29,402	29,423	29,431	29,452	29,472	29,492	29,511	29,530	29,549	29,567	
Ventura	79,805	79,820	79,830	79,867	79,890	79,911	79,931	79,950	79,967	79,984	79,999	

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- **Beds:** For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report ([MMWR, March 18, 2020](#)) and state reports of COVID-19 cases.
- **ICU:** The CDC report found that 24% of hospitalized cases require ICU care.
- **Ventilators:** Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.

California Medical Demand by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:											
	4/4	4/5	4/6	4/7	4/9			4/11			4/13					
Alameda	83,861	83,951	84,007	84,091	84,298	(16,860)	[4,046]	{2,023}	84,510	(16,902)	[4,056]	{2,028}	84,728	(16,946)	[4,067]	{2,033}
Contra Costa	65,665	65,718	65,835	65,882	66,026	(13,205)	[3,169]	{1,585}	66,170	(13,234)	[3,176]	{1,588}	66,310	(13,262)	[3,183]	{1,591}
Fresno	99,602	99,702	99,755	99,814	99,996	(19,999)	[4,800]	{2,400}	100,181	(20,036)	[4,809]	{2,404}	100,350	(20,070)	[4,817]	{2,408}
Kern	106,430	106,480	106,543	106,628	106,698	(21,340)	[5,122]	{2,561}	106,764	(21,353)	[5,125]	{2,562}	106,820	(21,364)	[5,127]	{2,564}
Lake	3,350	3,355	3,359	3,358	3,365	(673)	[162]	{81}	3,371	(674)	[162]	{81}	3,378	(676)	[162]	{81}
Los Angeles	1,221,950	1,222,479	1,222,802	1,223,205	1,224,106	(244,821)	[58,757]	{29,379}	1,224,996	(244,999)	[58,800]	{29,400}	1,225,859	(245,172)	[58,841]	{29,421}
Marin	13,724	13,730	13,743	13,760	13,778	(2,756)	[661]	{331}	13,795	(2,759)	[662]	{331}	13,810	(2,762)	[663]	{331}
Monterey	42,994	43,002	43,038	43,057	43,082	(8,616)	[2,068]	{1,034}	43,104	(8,621)	[2,069]	{1,034}	43,126	(8,625)	[2,070]	{1,035}
Orange	266,822	267,001	267,143	267,253	267,540	(53,508)	[12,842]	{6,421}	267,827	(53,565)	[12,856]	{6,428}	268,114	(53,623)	[12,869]	{6,435}
Placer	21,157	21,188	21,239	21,287	21,387	(4,277)	[1,027]	{513}	21,492	(4,298)	[1,032]	{516}	21,601	(4,320)	[1,037]	{518}
Riverside	295,196	295,426	295,631	295,770	296,195	(59,239)	[14,217]	{7,109}	296,644	(59,329)	[14,239]	{7,119}	297,130	(59,426)	[14,262]	{7,131}
Sacramento	98,660	98,848	99,042	99,157	99,582	(19,916)	[4,780]	{2,390}	100,018	(20,004)	[4,801]	{2,400}	100,474	(20,095)	[4,823]	{2,411}
San Bernardino	291,551	291,727	291,728	291,989	292,299	(58,460)	[14,030]	{7,015}	292,614	(58,523)	[14,045]	{7,023}	292,933	(58,587)	[14,061]	{7,030}
San Diego	271,335	271,654	271,866	272,194	272,675	(54,535)	[13,088]	{6,544}	273,139	(54,628)	[13,111]	{6,555}	273,581	(54,716)	[13,132]	{6,566}
San Francisco	35,488	35,525	35,538	35,572	35,634	(7,127)	[1,710]	{855}	35,697	(7,139)	[1,713]	{857}	35,762	(7,152)	[1,717]	{858}
San Joaquin	70,202	70,245	70,465	70,511	70,686	(14,137)	[3,393]	{1,696}	70,876	(14,175)	[3,402]	{1,701}	71,065	(14,213)	[3,411]	{1,706}
San Luis Obispo	20,586	20,606	20,649	20,671	20,716	(4,143)	[994]	{497}	20,760	(4,152)	[996]	{498}	20,805	(4,161)	[999]	{499}
San Mateo	40,560	40,595	40,618	40,649	40,725	(8,145)	[1,955]	{977}	40,799	(8,160)	[1,958]	{979}	40,872	(8,174)	[1,962]	{981}
Santa Barbara	33,329	33,358	33,381	33,408	33,472	(6,694)	[1,607]	{803}	33,535	(6,707)	[1,610]	{805}	33,598	(6,720)	[1,613]	{806}
Santa Clara	114,865	115,171	115,266	115,396	115,601	(23,120)	[5,549]	{2,774}	115,807	(23,161)	[5,559]	{2,779}	116,007	(23,201)	[5,568]	{2,784}
Santa Cruz	15,292	15,278	15,264	15,283	15,312	(3,062)	[735]	{367}	15,342	(3,068)	[736]	{368}	15,369	(3,074)	[738]	{369}
Solano	31,368	31,401	31,432	31,462	31,538	(6,308)	[1,514]	{757}	31,614	(6,323)	[1,517]	{759}	31,691	(6,338)	[1,521]	{761}
Sonoma	29,315	29,402	29,423	29,431	29,472	(5,894)	[1,415]	{707}	29,511	(5,902)	[1,417]	{708}	29,549	(5,910)	[1,418]	{709}
Ventura	79,805	79,820	79,830	79,867	79,911	(15,982)	[3,836]	{1,918}	79,950	(15,990)	[3,838]	{1,919}	79,984	(15,997)	[3,839]	{1,920}

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.